CLAIMS

1. Iterative method for decoding a signal vector Y obtained from N sampled signals in a space-time communication system with M transmit antennae and N receive antennae, with N greater than or equal to M, with a view to obtaining an estimation of the symbols of the signals transmitted; characterized in that each iteration comprises the following steps:

- Pre-processing of the vector Y in order to maximize the signal to noise+interference ratio in order to obtain a signal $\tilde{r}^{\ell}$,

- Subtraction from the signal $\tilde{r}^{\ell}$ of a signal $\hat{z}^{\ell}$ by means of a subtractor, the signal $\hat{z}^{\ell}$ being obtained by reconstruction post-processing of the interference between symbols from the symbols estimated during the preceding iteration,

- Detection of the signal generated by the subtractor in order to obtain, for the iteration in progress, an estimation of the symbols of the signals transmitted;

and in that, the N signals being processed by time intervals T corresponding to the time length of the linear space-time code associated with the transmitted signals, the pre-processing step involves the matrix B in order to maximize the signal to noise+interference ratio, the transfer function of which is:

$$B^{\ell}=Diag\left(\frac{1}{\rho_{\ell-1}^{2}A_{i}^{\ell}+\frac{N_0}{E_S}}\right)_{1\leq i\leq MT}.C^{H}V^{\ell}$$

with $$V^{\ell}=\left[\frac{1-\rho_{\ell-1}^{2}}{\frac{N_0}{E_S}}.C\cdot C^{H}+Id_N\right]^{-1} \quad ; \quad A^{\ell}=diag\left(C^{H}\cdot V^{\ell}\cdot C\right) \; ;$$

ℓ: iteration index; ρ: standardized correlation coefficient between the real symbols and the estimated symbols; N_0: noise variance; Es: mean energy of a symbol; C: extended channel matrix;

and in that the post-processing step involves a matrix D for the reconstruction of the interference between symbols, the transfer function of which is:

$$D^{\ell}= B^{\ell}.C\cdot \rho_{\ell-1} - Diag\left[\frac{1}{\rho^{2}_{\ell-1}A^{\ell}_{i}+\dfrac{N_0}{E_s}}\right] 1\leq i\leq MT$$

2. Method according to claim 1, characterized in that the pre-processing step is carried out by operating a matrix multiplication between the signal vector Y and a matrix B, the matrix B being updated at each iteration.

3. Method according to claim 1 or 2, characterized in that the post-processing step is carried out by operating a matrix multiplication between the vector of the symbols estimated during the preceding iteration and the matrix D, the matrix D being updated at each iteration.

4. Method according to claim 2 or 3, characterized in that for each iteration, the standardized correlation coefficient ρ is calculated, the updating of a matrix being achieved by determining new coefficients of the matrix as a function of the correlation coefficient obtained for the preceding iteration.

5. Method according to any one of the preceding claims, characterized in that in order to determine the correlation coefficient ρ^{ℓ} for each iteration:

- the signal to interference ratio SINR is calculated using the following formula: $\mathbf{SINR}^{\ell}=\left[\dfrac{1}{\xi^{\ell}e^{\xi^{\ell}}E_1\left(\xi^{\ell}\right)}-1\right]\dfrac{1}{1-\rho^{2}_{\ell-1}}$

and defining the integral exponential $E_1(s)=\int_s^{+\infty}\frac{e^{-t}}{t}dt$

with $\xi^{\ell}=\dfrac{\varsigma}{1-\rho^{2}_{\ell-1}}$ and $\varsigma=\dfrac{N_0}{NE_s}$

- the symbol error probability Pr is calculated from the signal to interference ratio SINR$'$; and

- the correlation coefficient ρ' is then calculated from the symbol error probability Pr.

6. Method according to claim 5, characterized in that it is assumed that $\rho^0 = 0$.

7. Method according to claim 5 or 6, characterized in that in order to calculate the symbol error probability Pr it is assumed that the total noise is Gaussian.

8. Method according to claim 7, characterized in that the formula corresponding to the constellation originating from a linear modulation transmission is used.

9. Method according to any one of claims 5 to 8, characterized in that, in order to calculate the correlation coefficient ρ' from the symbol error probability Pr, it is assumed that when there is an error, the threshold detector detects one of the closest neighbours to the symbol transmitted.

10. Method according to any one of the preceding claims, characterized in that, at the final iteration, the signal leaving the subtractor is introduced into a soft-input decoder.

11. Method according to any one of the preceding claims, characterized in that the information symbols are elements of a constellation originating from a quadrature amplitude modulation.

12. Space-time decoder implementing a method according to any one of the preceding claims, for decoding a signal vector Y obtained from N sampled signals in a space-time communication system with M transmit antennae and N receive antennae, with N greater than or equal to

M, with a view to obtaining an estimation of the symbols of the signals transmitted, characterized in that it comprises:

- a pre-processing module of the vector Y for maximizing the signal to noise+interference ratio in order to obtain a signal $\tilde{r}^{\ell}$,
- a subtractor for subtracting a signal $\hat{z}^{\ell}$ from the signal $\tilde{r}^{\ell}$,
- a post-processing module for the reconstruction of the interference between symbols from the symbols estimated during the preceding iteration in order to generate the signal $\hat{z}^{\ell}$,
- a threshold detector for detecting the signal generated by the subtractor in order to obtain, for the iteration in progress, an estimation of the symbols of the signals transmitted;

and in that the N signals being processed by intervals of time T corresponding to the time length of the linear space-time code associated with the transmission signals, the pre-processing module consists of a matrix B for maximizing the signal to noise+interference ratio, the transfer function of which is:

$$B^{\ell}=Diag\left(\frac{1}{\rho_{\ell-1}^{2}A_i^{\ell}+\frac{N_0}{E_S}}\right)_{1\leq i\leq MT}.C^H V^{\ell}$$

with $$V^{\ell}=\left[\frac{1-\rho_{\ell-1}^{2}}{\frac{N_0}{E_S}}.C\cdot C^H+Id_N\right]^{-1} \quad ; \quad A^{\ell}=diag\left(C^H\cdot V^{\ell}\cdot C\right) \; ;$$

ℓ: iteration index; ρ: standardized correlation coefficient between the real symbols and the estimated symbols; N_0: noise variance; Es: mean energy of a symbol; C: extended channel matrix.

and in that the post-processing module consists of a matrix D for the reconstruction of the interference between symbols, the transfer function of which is:

$$D^{\ell}=B^{\ell}.C\cdot\rho_{\ell-1}-Diag\left(\frac{1}{\rho_{\ell-1}^{2}A_i^{\ell}+\frac{N_0}{E_S}}\right)_{1\leq i\leq MT}$$

13. Decoder according to claim 12, characterized in that it comprises a soft input decoder receiving the signal originating from the subtractor during the final iteration.